Disclosure

KCI Canada
CSL Behring
NovoNordisk
Lessons Learned in Trauma

1. It is possible to change practice
2. It is possible to have good trials
3. Still don’t know what’s right/wrong
4. Practice according to culture
Trauma Resuscitation

Unique:
- anemia & oxygenation
- circulatory volume
- stop bleeding
- coagulopathy (complex)
- acid-base balance
- temperature, Ca, hyperkalemia
- ambulance & trauma room

It’s a metabolic mess!
Possible to Change Practice

Resuscitation from crystalloid to BLOOD

Reasons: XX century = crystalloid is bad
brain, lung, bowel edema
open abdomen
dilution = more coagulopathy
more transfusion
more hypothermia
Possible to Change Practice

Crystalloid to BLOOD
XXI century = trauma-coagulopathy

Bleeding

Dilution

Coagulopathy

Hypothermia
Acidosis
Etc; etc

XXI Century
• Endogenous
• Early
• 25% patients
• 3x mortality
• NOT addressed
XXI Century Wars

Afghanistan & Iraq wars = blood is good!
subset patients
young, coagulopathic & massive bleeding
widespread tissue trauma
extremity (*tourniquet*)
blast & explosion
logistic, transportation, hospitals

Mobile blood bank = fresh whole blood
XXI Century Wars

Afghanistan & Iraq wars = blood is good!
treat massive bleeding = whole blood early

DIFFERENT
XXI Century

Lessons wars transferred home
NO whole blood – ratio 1:1:1 \((RBC:FFP:plat)\)

ONLY blood 1:1:1 = effective concentration
- clotting factor 65%
- platelet 55x10^9/L (37x10^9/L)
- hematocrit 26%

Anything else = more dilution
## Retrospective Studies

### Damage Control Resuscitation

<table>
<thead>
<tr>
<th></th>
<th>1:1:1</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duschene</td>
<td>26%</td>
<td>88%</td>
</tr>
<tr>
<td>Maegele</td>
<td>24%</td>
<td>46%</td>
</tr>
<tr>
<td>Holcomb</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>Kashuk</td>
<td>8%</td>
<td>40%</td>
</tr>
<tr>
<td>Scalea</td>
<td></td>
<td>No difference</td>
</tr>
<tr>
<td>Teixeira</td>
<td>26%</td>
<td>90%</td>
</tr>
<tr>
<td>Zink</td>
<td>26%</td>
<td>55%</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td><strong>26%</strong></td>
<td><strong>55%</strong></td>
</tr>
</tbody>
</table>
Change in Practice

1. crystalloids are bad
2. whole blood – 1:1:1
   not perfect
   best in existence

Trauma Centers North America:
hypotension = blood transfusion
EARLY
Transfusion of Plasma, Plat, RBC in a 1:1:1 vs. 1:1:2

**PROPPR** Randomized Clinical Trial

*JAMA.* 2015;313(5):471-482

- 680 severely injured patients
- 12 Trauma Centres – Aug 2012 to Dec 2013

- **No difference mortality 24h & 30d**

- More plasma 7U vs. 5U
- More platelets 12U vs. 6U
- No difference complications (*ARDS, MOD, VTE, sepsis*)

- Fewer death by exsanguination 24h
- More patients achieved hemostasis
However

Massive bleed – exchange transfusion replace entire blood volume

90% NO transfusion
1.7% \( >10 \text{U/24h} \) = massive transfusion
46% \( >10 \text{u/24h} \) in PROPPR

Early = better outcome in massive bleed
Blood & Civilians

Civilian = cars & falls, old, not fit, co-morbidities

Inappropriate RBC transfusion (Dr. Callum): retrospective study Toronto
4214 admissions – 541 transfused RBC
27.5% inappropriate
risk: age, penetrating, ISS, coagulopathy
more VTE events (MI, stroke)
Furthermore

**More RBC = more plasma**

- Q2u RBC = 10% drop clotting factors
- 8-10u RBC = 25% clotting factors remain

**More RBC = more platelets**

- 10-12u RBC = platelet drop by 50%

**More RBC = more interventions**

- Q2u RBC = 10-20ml calcium gluconate
1:1 vs. Lab-Guided

TRFL study (Nascimento, CMAJ 2013)

feasibility – 78 patients
1:1 vs. lab-guided

NO clinical benefit
mortality, ARDS \((p.053)\)
waste blood
inappropriate transfusion
Possible to Have Good Trials

**Tranexamic acid:**
CRASH 2 – *Lancet* 2010
20,211 patient RCT
TXA lower mortality (3h ??)

MATTERs – *Arch Surg* 2012
MATTERs 2 – *JAMA Surg* 2013
TXA = lower mortality (transfused)
TXA/cryo = mortality & transfusion
Different Culture & Perspectives

TXA & fibrinogen – Europe

**Fibrinogen (cryo/concentrate):**
1\textsuperscript{st} drop – essential – level
European guidelines = 1.5-2g/L
hemoglobin <8 = low fibrinogen
ISS>30 = 50% <1g/L
need transfusion & mortality

Fibrinogen first – NOT plasma
Different Culture & Perspectives

USA = resistance TXA
fibrinolysis fatal (black diamond)
questions CRASH & physiol. fibrinolysis
local evidence plasma
fibrinogen (cryo) late or none

Canada = TXA accepted low compliance
active strategies, pre-hospital
interest fibrinogen 1st
Good Trials? More Trials

Not always
fibrinogen – growing fast

Less attractive issues:
stop bleeding fast superior to transfusion
access to OR – immediate ($$)
under developed = no blood = earlier OR
What’s Right

1. Best volume replacement?
   * plasma? crystalloid + RBC + fibrinogen?  
   * add vasopressors?

2. How identify massive bleeding
   * acceptable start 1:1:1  
   * change asap lab-directed (viscoelastic?)

3. If blind resuscitation, start fibrinogen?
   * TXA must *(protocols, blood management program)*
Lessons Learned

1. Possible change practice
crystalloid to blood resuscitation

2. Possible have good trials
PROPPR 1:1:1 – massive bleed
CRASH & MATTERS – TXA
fibrinogen

3. What’s right – culture
most patients = restrictive, lab-guided
most practice depend group
Thank you